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FINAL SITE INSPECTION PRIORITIZATION REPORT

TEXAS INSTRUMENTS, INC.

ATTLEBORO, MASSACHUSETTS

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION I
Office of Site Remediation and Restoration
Boston, MA

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TDD No. 9706-01-CSX

INTRODUCTION

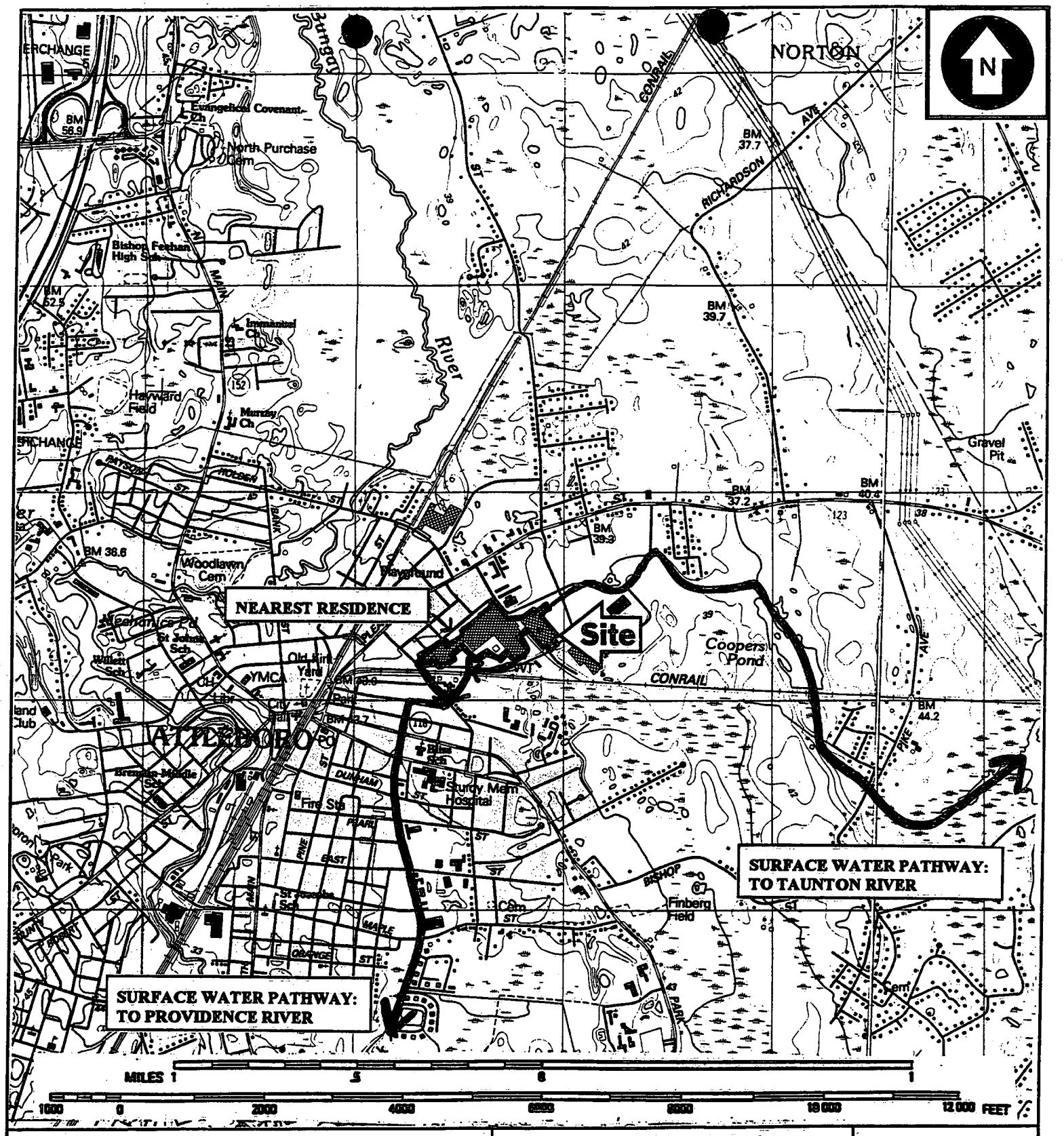
Stone & Webster Environmental Technology & Services (Stone & Webster) was requested by the U.S. Environmental Protection Agency Region I (EPA Region I) Office of Site Remediation and Restoration to perform a Site Inspection Prioritization (SIP) of the Texas Instruments, Inc. site in Attleboro, Massachusetts. All tasks were conducted in accordance with the New England Corps of Engineers Contract No. DACW33-94-D-0007, which was issued to Stone & Webster on June 24, 1994, and Delivery Order 0030 issued April 15,1997. A Preliminary Assessment (PA) of this property was completed in 1985 under the Massachusetts FIT Contract, and a Site Inspection (SI) was conducted by Wehran for the site in August 1985. Updated information since the last EPA activity encountered during the SIP process is included in this report. Relevant text from the Site Inspection (Phase I Investigation) Report is presented in this report in italics.

Background information used in the generation of this report was obtained through file searches conducted at EPA Wilmington, EPA Canal Street, the Massachusetts Department of Environmental Protection (MADEP) and the Attleboro City Hall. Conversations were held with Attleboro Department of Public Works officials, and telephone interviews were held with water departments in surrounding communities. Information was obtained through computer database searches, and conversations with other Federal, State, and local agencies. Additional information was obtained during Stone & Webster's onsite reconnaissance on December 10, 1997.

This package follows guidelines developed under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended, commonly referred to as Superfund. However, these documents do not necessarily fulfill the requirements of other EPA regulations, such as those under the Resource Conservation and Recovery Act (RCRA) or other Federal, State, and local regulations. An SIP is intended to provide a preliminary screening of sites to facilitate EPA's assignment of site priorities. It is a limited effort, and is not intended to supersede more detailed investigations.

SITE DESCRIPTION

Texas Instruments, Inc. (TI) is located at 34 Forest Street in Attleboro, Massachusetts, approximately 1.4 miles east of Route 95 and 0.5 miles east of the Ten Mile River at latitude 41°56' 55" and longitude 71°16' 09". A site location map is included as Figure 1. The site is approximately 275 acres in size, 30 acres of which are paved parking areas. Approximately one-third of the TI property has been developed. Undeveloped portions of the site are generally wooded.[5] There are 17 industrial manufacturing and/or office buildings located on site. A sketch showing the overall vicinity of the site is included as Figure 2. A site sketch is included as Figure 3.



BASE MAP IS A PORTION OF ATTLEBORO (1987), AND TAUNTON (1987) MASSACHUSETTS 7.5 MINUTE SERIES USGS TOPOGRAPHIC MAPS.

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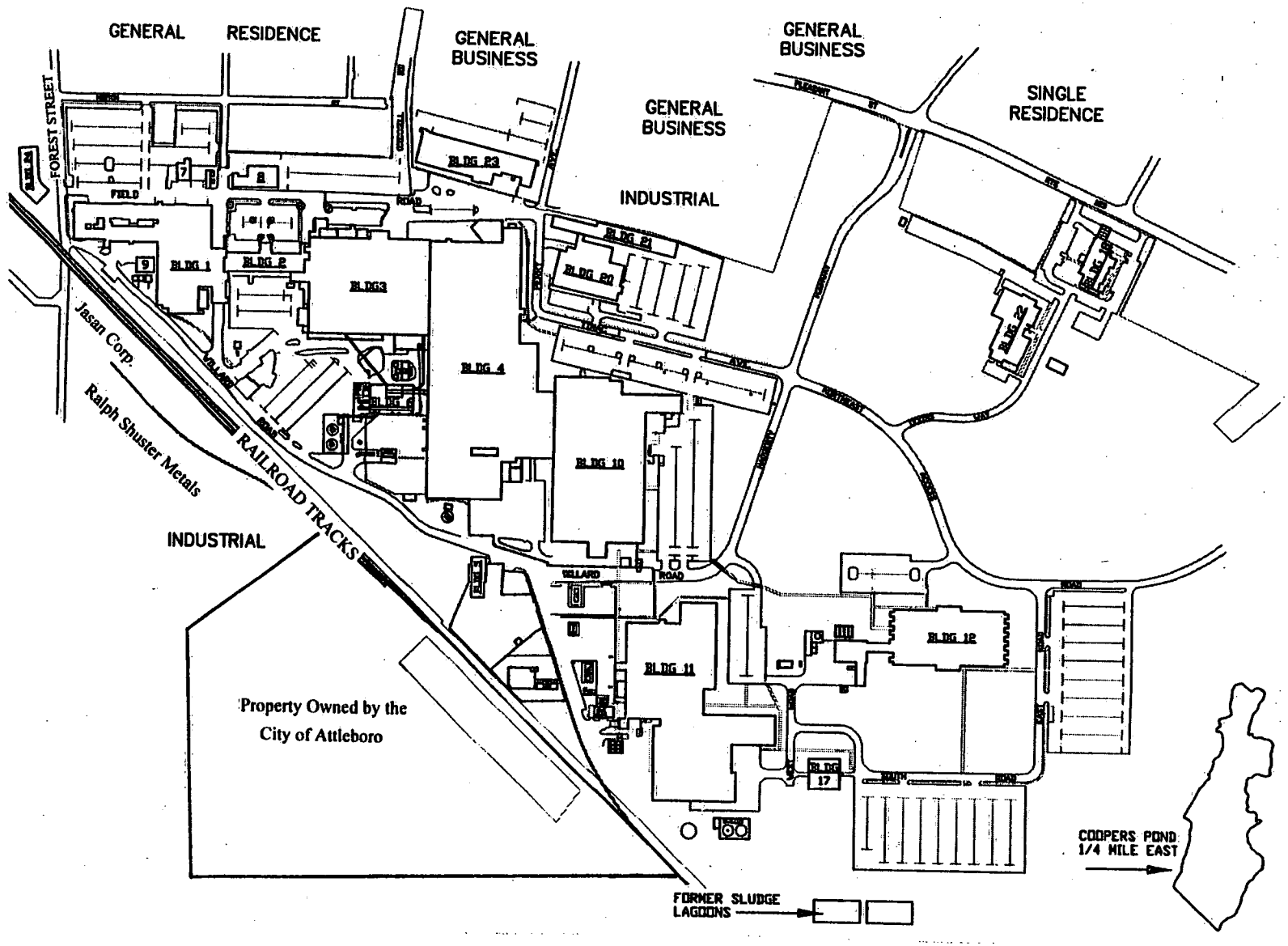
Site Location Map
TEXAS INSTRUMENTS, INC.
Figure 1



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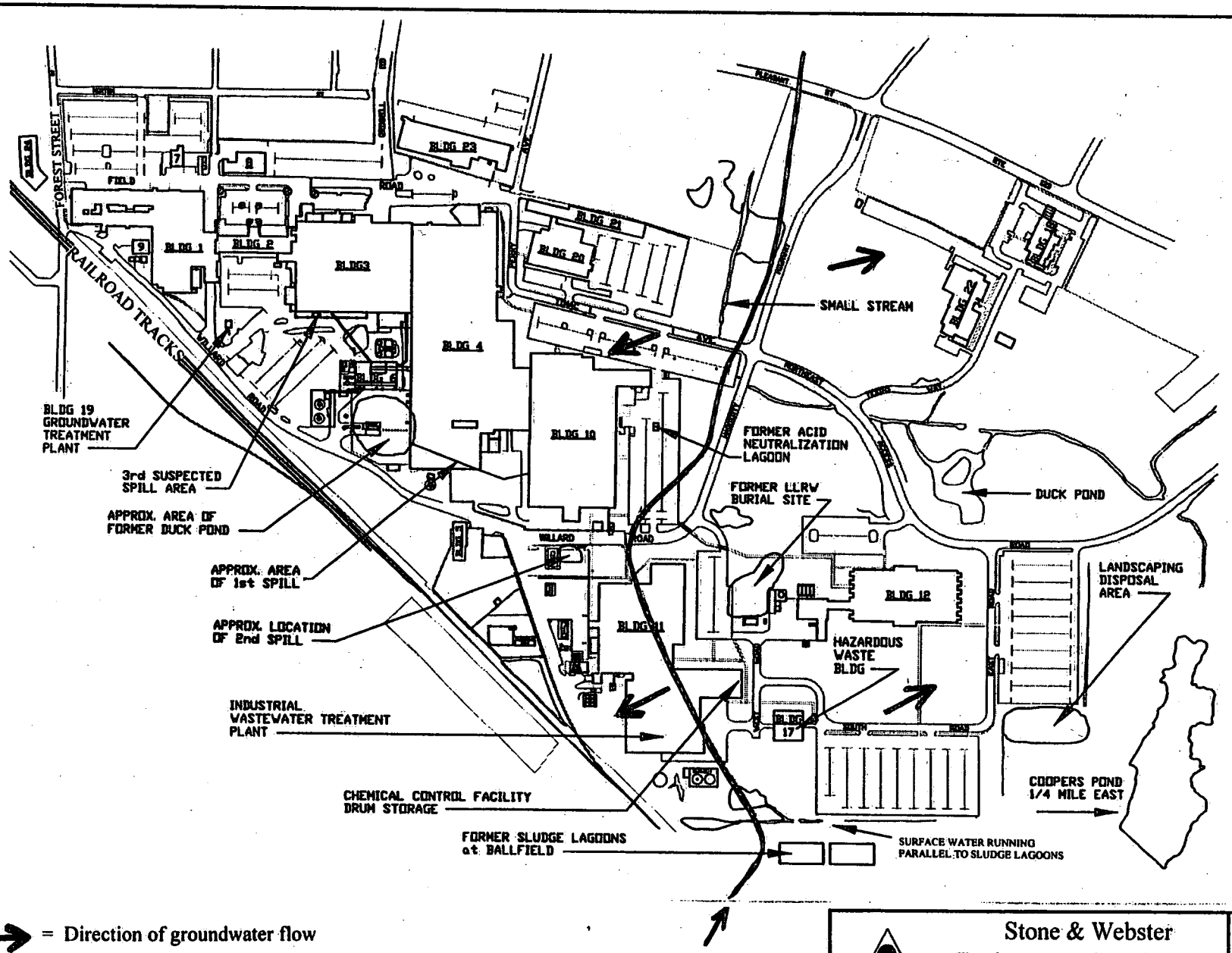
NOT TO SCALE

Source of map: Texas Instruments

Site Vicinity Map
TEXAS INSTRUMENTS, INC.
Figure 2



→ = Direction of groundwater flow

Groundwater/Surface Water Divide

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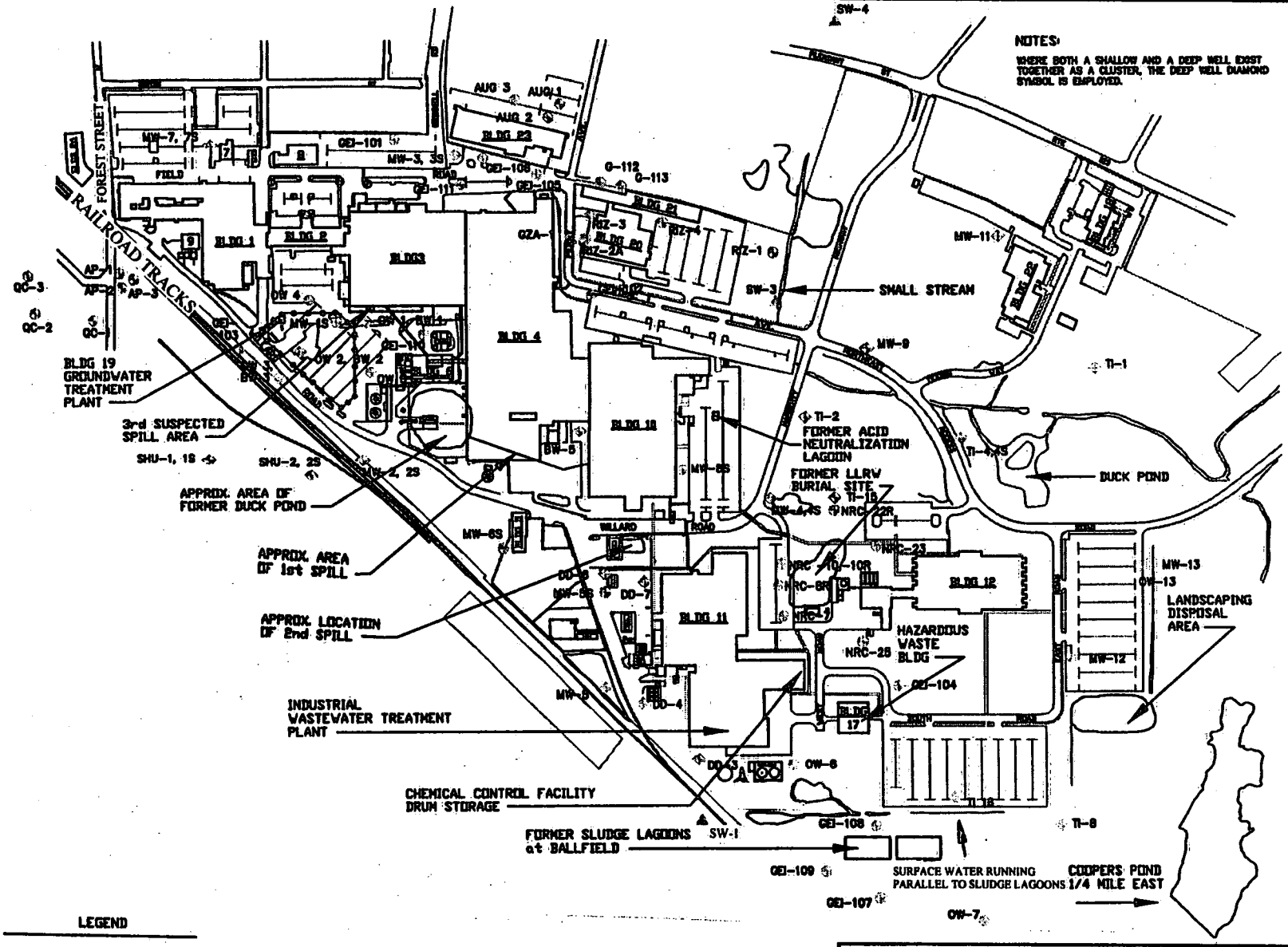
Site Sketch
TEXAS INSTRUMENTS, INC.
Figure 3

NOT TO SCALE

Source of map: Texas Instruments



NOT TO SCALE

Source of map: Texas Instruments

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Site Sketch with Sampling Locations
TEXAS INSTRUMENTS, INC.
Figure 4

TI is located on Assessor's Map 52, Lots 109A, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128; Assessor's Map 56 Lots 4A, 4B, 4B-1, 4C, 10A, 10B, 11, 12, 13, 14, 14A, and 15.[37]

The site is located in a mixed industrial/residential area. The site is bordered by residences to the northwest; general industrial businesses to the north; Cooper's Pond to the east; and Jasan Corporation, Ralph Shuster Metals, Inc., and property owned by the City of Attleboro to the southwest.[37] See Figure 2, Site Vicinity Map.

The TI site is essentially flat. The eastern portion of the site is approximately 135 feet above sea level. The western portion of the site is approximately 124 feet above sea level, allowing for an approximate 10 foot change in elevation across the site. Site access is unrestricted. Several private roads traverse the site and, although the roads have gates that can be closed at times, normally, the general public has access to these roads. These roads are not heavily traveled; the site is located in the eastern portion of the City of Attleboro, and land beyond the site to the east is not commercially developed (zoned residential). There is a landscaped walking trail on site, as well as two ball fields used by TI employees.[5]

There are several surface water bodies on site (see Figure 3). A small stream is located in the northern portion of the site, to the east of Building 20. Additionally, there is surface water running parallel to the sludge lagoons in the southern portion of the site. Finally, there is a duck pond located to the north/northeast of Building 12.[5]

The TI facility is a major industrial plant in southeastern Massachusetts, manufacturing clad metals, electronic control devices, and assorted formed-metal products. Numerous oils and hazardous materials are stored and used at the site. The site maintains over 3,000 Material Safety Data Sheets (MSDSs), and in 1993, 24 chemicals were reported under subtitle B, section 312 of SARA, Title III, "Community Right-to-Know." (Note: these chemicals are listed in the Operational and Regulatory History and Waste Characteristics section of this report.) The site is listed as a confirmed non-priority disposal site by MADEP.[2]

The following is a list of buildings on site, their description, and their function.

Building 1 - A two-story brick structure fronting Forest Street. Houses administrative offices, a computer center, and manufacturing operations for Thermostat Discs, Motor Controls and Molding.[38]

Building 2 - A two-story brick structure connecting Building 1 and Building 3 fronting Field Road. Houses general offices and an employee cafeteria.[38]

Building 3 - Located on Field Road connecting Buildings 2 and 4. Brick construction, high bays with a two-story office. Houses Thermostat Metal and Precision Engineered Parts (operations involving rolling mills and other heavy machinery), offices, and the Security Department. Steel frame and metal siding additions recently constructed house rolling mills, furnaces, and metal storage.[38]

Building 4 - Steel-frame metal-sided building with brick fronted two-story office attached. Located at the intersection of Field Road and Perry Avenue connecting Buildings 3 and 10. Houses Industrial Metals, Thermostat Metals, Precision Technologies, rolling mills, heavy machinery, and storage.[38]

Building 5 - A small salvage shop of brick, wood and metal siding. Located on Willard Road, behind Building 4.[38]

Building 6 - Brick structure, which houses TI's Central Utility Plant, located behind Buildings 3 and 4. Supplies steam, compressed air, and gases to most of the site.[38]

Building 7 - Garage-type brick building on Field Road. Houses a sheet metal shop.[38]

Building 8 - Garage-type brick structure on Field Road. Houses a carpenter shop and vending storage.[38]

Building 9 - Steel-frame metal-sided building located behind Building 1 on Willard Road, just off Forest Street. Provides water cooling, air conditioning, and compressed air for Buildings 1 and 2.[38]

Building 10 - A two-story brick building located on Timac Avenue connecting with Building 4. Houses wire manufacturing operations, stamp presses, research laboratories, marketing offices, and manufacturing. Materials Administration, Environmental/Safety and Health Offices, and Facilities Department are located here.[38]

Building 11 - Concrete brick and metal siding building located on Willard Road at Haggerty Highway. Houses stamp presses, furnaces, and assembly operations for Attleboro Lead Frames. Steel-frame metal-sided addition houses Plating, the Wastewater Treatment Plant, Chemical Storage, and Shipping and Receiving.[38] Building 11 is the site's chemical control facility. All chemicals are received through this facility and then distributed to the appropriate manufacturing buildings.

Building 12 - Three-story concrete building located off Northeast Access Road. First floor: assembly and small press area, cafeteria, administration offices, and Annex Central Utility Plant. Second floor: offices, warehousing, and light manufacturing. Third floor: Offices and assembly operations.[38]

Building 17 - A steel-frame, metal-sided structure located east of Building 11 and south of Building 12. Building 17 is a totally enclosed, ventilated hazardous waste storage facility at TI. It is designed to be an explosion-proof facility. Building 17 houses wastes that include flammable materials, acids, cyanides, waste barium, solid wastes, trichloroethylene (TCE), and mixed solid waste. In addition, virgin oils are also stored separately in the building, as well as numerous empty drums for recycling. Building 17 also contains a bottled gas storage room and a cyanide storage room. At the time of the December 1997 Stone & Webster site reconnaissance, there were approximately 50 drums of waste stored in the building.[5]

Spill containment in Building 17 is provided by four 250-gallon holding trenches and one 3,000-gallon holding trench, located in the center of the building. All spill control trenches located within the building are designed to contain any spill within the structure itself. The trenches have grated tops to allow easy access for pumping and visual inspections. Spill control is designed to separate flammables, oxidizers, acids, and cyanides by providing a separate spill containment for each.[3]

Building 18 - TI Federal Credit Union. Concrete and brick structure located on 607 Pleasant Street, Route 123.[38]

Building 19 - Steel-frame metal-sided structure off Willard Road behind Building 2. Houses the groundwater treatment facility.[38]

Building 20 - Two-story concrete block structure on Perry Avenue. Houses Graphic Arts, Education and Development, Facilities, R&M Administration, former Print Shop, Model Shop, Machine Shop and Transportation office.[38]

Building 21 - One-story concrete block structure connecting to Building 20 located on Perry Avenue. Houses screw machine operations.[38]

Building 22 - Texins Activity Center, block and brick construction located on Texins Way, behind Building 18. Houses a recreation facility, a lap pool, a gym, a weight room, an aerobics room, meeting rooms, and administration offices.[38]

Building 23 - Located at 33 Perry Avenue. Two-story concrete and brick structure that houses the Business Intelligence Library, Group Quality and Precision Controls Marketing, Purchasing, Control & Finance, and Customer Service personnel.[38] The building is not owned by TI, but rather leased from Thomas & Betts.[46]

Building 24 - Located at 25 Forest Street. Single-story concrete block and brick structure that houses Education and Development Facilities.[38] The building is not owned by TI, but, rather leased from D&G Realty.[46]

The following is a list of outdoor chemical storage areas and the buildings near where they are located. The chemicals are stored in 20 above ground (ASTs) and underground (USTs) tanks with containment as described in the source evaluation section (all tanks are aboveground unless otherwise noted).

- Building 1 - mineral oil/methanol (UST - temporarily out of service)
- Building 4 - Diesel fuel oil
- Building 6 - Fuel oil/TCE/diesel fuel
- Building 10- Gasoline (UST - temporarily out of service)
- Building 11 - Ferrous sulfate/sulfuric acid/diesel fuel/ferric chloride
- Building 12 - Fuel oil/diesel oil

Three disposal areas (see Figure 3) have been identified on site: a landscape material disposal area, a metal hydroxide sludge disposal site, and a former burial area. A landscape disposal area, which receives shrubbery, grass clippings, leaves, and mulch, is located east of Building 12 and is currently in use (in 1994). Southeast of Building 17 there is a former metal hydroxide sludge disposal site which was closed, capped, and seeded in 1981, and is now used as a ball field. Finally, there is a former burial area between Buildings 11 and 12 for low-level radioactive, contaminated material, as recommended by the Atomic Energy Commission (AEC). Burial activities occurred from approximately the late 1950s to the early 1960s. The radioactive burial site was remediated during 1992 and 1993 under the direction of the Nuclear Regulatory Commission.[2] Details regarding this remediation were unavailable during review for this report.

There are 11 CERCLIS sites and 46 RCRA sites located within one mile of the TI site.[7] These sites are listed in Appendix A.

OPERATIONAL AND REGULATORY HISTORY AND WASTE CHARACTERISTICS

Since the turn of the century, the TI site has been used as an industrial facility. General Plate Corporation was the first owner of the site, from 1926 to 1931. Operations at General Plate included manufacturing of metals and metal products. In 1931, General Plate merged with Spencer Thermostat of Cambridge, Massachusetts, and formed a new company called Metals and Controls Company. Metals and Controls Company operated on this site from 1931 to 1959, at which time it merged with *TI.*[46] Since 1959, TI has owned and operated the land and facility. In 1988, TI purchased the land and buildings previously owned and operated from 1972 by Augat, Inc. located on 40 Perry Avenue, and incorporated it into the site. [2]

According to TI employees, there have been two chemical spills that occurred on the TI site in 1959 and 1960. *The first spill involved a leak from a nitric acid line, which in turn dissolved a ceramic line feeding solvent into Building 10. The spill reportedly originated near Building 10 and flowed into the original duck pond (later filled in) near Building 4. The spilled solvent was reportedly TCE. The total amount spilled was unknown. It is also unknown whether any cleanup of the spill or contaminated soil was carried out following the spill.*

The second spill occurred near Building 11 in a tank and drum storage area. Overflow from a nitric acid tank corroded a line to a solvent tank containing TCE. The spill containing both nitric acid and solvent flowed onto a nearby road bed and unpaved parking area. According to representatives of TI, contaminated soil was removed from this area and disposed of in another (unknown) location. The quantity of chemicals involved in this spill event is unknown. (Note: this disposal is further discussed later on in the chronological history).

A third suspected spill area is between Building 3 and 6 where tanks with solvents and drum storage were located in the past.

An industrial wastewater treatment plant was constructed in 1977 in an addition built to Building 11. The plant was designed primarily to treat metal bearing waste waters from the site's

manufacturing operations. In accordance with a National Pollutant Discharge Elimination System (NPDES) permit this system currently discharges effluent to Cooper's Pond, located approximately 1/4 mile to the east. The treatment plant underwent a major upgrade which was completed in 1988 to meet new water quality discharge criteria.[2] Using a 24-hour composite, flow-weighted sampling device, the plant's effluent is sampled twice per week and analyzed for chemical contamination by EPA protocol. Since commencing operation of the wastewater treatment plant, TI attests that it has consistently achieved compliance with its NPDES permit discharge limits.[10] (Note: in a follow-up telephone conversation, TI personnel claimed to have had "excursions" to permit limits in that permit limits have been slightly exceeded [generally by under two times the permit limit] but only at one time or another [i.e., not consecutively].)[48]

Prior to 1977, industrial wastewater lines were treated individually. Individual lines which had been treated were discharged to the storm sewer. Metal finishing wastewater (highly contaminated with metals) was sent to the Attleboro POTW (Publicly-owned Treatment Works). Cyanide destruction units were located behind Buildings 3 (which discharged to the Ten Mile River) and 11 (which discharged to Cooper's Pond).[39]

TI has also disposed of construction and demolition debris *on site in the past. No information is available on the quantities involved* or the exact location of disposal.[46]

Two sludge lagoons existed near the southeast corner of the site, southeast of Building 17. It is reported that both sodium hydroxide and caustic sludges were deposited into these lagoons. In December 1980, a ground penetrating radar (GPR) survey was conducted on the sludge lagoon area to determine the underlying ground conditions. This field work confirmed the presence of a clay layer. No new waste has been deposited in the lagoons since November 19, 1980, the effective date of RCRA regulations. Composite samples from each lagoon were collected and analyzed for EP Toxicity. Laboratory analytical results indicated the presence of mercury only, which was detected above background levels at 2.1 ppm.[23]

In March 1981, a pH survey of the sludge was completed by TI, as well as metal analysis of the surface water running parallel to the sludge lagoons. (Note: Detailed sampling results of each sampling effort mentioned here and below are presented in the respective Groundwater, Surface Water, Soil Exposure, and Air Pathway sections.)

The sludge lagoons were closed and capped in 1981 with 3 inches of lime followed by 1 foot of clay and 2 feet of fill, loam, and grading. All work was done with full approval of Massachusetts Department of Environmental Quality Engineering (MADEQE) and EPA Region I.[25] (Note: MADEQE is the former name for the MADEP.)

A pit used to dispose of equipment contaminated by low-level radioactivity (located east of Building 10 and also referred to as the low-level radioactive burial site*), was covered* in approximately 1981.[46] *Previously contaminated soil may also have been disposed of in this area.* In 1981, *when a buried pipeline was laid through the disposal area, buried contaminated machinery and metallic parts were removed. This location is referred to as the NRC disposal*

area, and four NRC monitoring wells have been installed to monitor groundwater conditions near the disposal pit.

A small acid *neutralization pond* was *located east of Building 10 as shown by a 1965 aerial photograph of the site (Geotechnical Engineers, Inc., 1984).* The approximate size of this lagoon was 20 feet by 40 feet. TI personnel suggested (in 1994) that this lagoon was a potential source of the VOCs detected in the soil and groundwater in its vicinity in 1984. The acid neutralization lagoon was apparently filled in after 1965.[2]

Groundwater at the TI site was sampled numerous times in the past two decades due to the detection of contamination in TI's own production wells in 1983 and knowledge of previous chemical spills. *The samples were collected by TI, Environmental Systems Corporation* (ESC), NUS Corporation (NUS), and *Geotechnical Engineers, Inc.*(GEI), and are listed below. All groundwater sampling events are described in the Groundwater Pathway section of this report.

- TI sampled two wells assumed to be downstream of the sludge lagoons in April, 1981.
- A&W Artesian Well installed 11 bedrock and 8 overburden monitoring wells under the direction of ESC in December 1983.
- NUS performed a hydrogeological investigation in December 1983 and January 1984.
- Guild Drilling Co. installed 3 shallow and 1 deep bedrock monitoring wells under the direction of GEI in July 1984.
- TI has been performing semi-annual groundwater sampling since 1987.
- M&E prepared a Groundwater Contamination Study for the TI site in July 1990.

On October 4, 1983, TI requested a change in status from Treatment, Storage, and Disposal (TSD) Facility to Generator of hazardous waste. A September 9, 1985 letter to TI from the MADEQE confirmed that the status of the facility had been changed, since the facility no longer treated, stored (over 90 days), or disposed of hazardous waste at the site.[15] (Note: A Corporate decision had been made in November, 1980 not to store any wastes at the facility past 90 days. Since November 11, 1980, all wastes have been managed under Generator status.[16])

A Preliminary Assessment (PA) of the TI site was completed in 1985 by NUS FIT, focusing on the two sludge lagoons and the groundwater contamination recently detected in the onsite production wells. In recognition of the MADEQE's ongoing efforts to address these concerns, no Federal Superfund program actions were recommended following the PA.[49]

In May, 1985, a groundwater extraction and treatment system was installed to remediate the groundwater condition. This system, located in Building 19, continuously treats an average of 100 - 125 gallons per minute (gpm) of groundwater contaminated by chlorinated solvents.[2] The plant

utilizes a pentagonal shaped well recovery system containing 25 well points. The groundwater goes through primary and secondary stripping towers before being discharged to the storm drain (NPDES outfall 002). TI samples the effluent weekly.[2] The samples are analyzed for volatiles, purgeable halocarbons, and aromatics. Results are submitted to the MADEP annually.[46]

On January 11, 1989, the MADEQE issued a Notice of Noncompliance (NON) to TI for failure to post a sign with the words "Hazardous Waste" in hazardous waste accumulation areas. On the same date, the MADEQE issued a NON to TI for accumulating hazardous waste on-site for greater than 90 days without being in compliance with TSD facility requirements. In addition, on January 11, 1989 the MADEQE issued a NON to TI for failure to keep all containers holding hazardous waste closed during storage.[17]

In April 1989, Virgin petroleum (#6) contaminated soils were discovered during a construction project in the area north of Building 6, west of Building 4, and south of Building 3. The contaminated soils surrounded the supply and return lines to an out-of-service (emptied and filled with sand) 60,000-gallon concrete underground storage tank (UST) which stored the oil. Soil samples were obtained for analyses and partial excavation of the contaminated soil was performed. A letter summarizing the remediation and results was submitted to the MADEP by TI on August 4, 1989. [2] (Note: this letter was unavailable during review for this report. Details of this sampling effort are unknown.)

On January 8 and 9, 1990, EPA and MADEQE personnel conducted a RCRA facility inspection at TI. A description of repeated noncompliance includes the following: a sign with the words "Hazardous Waste" was not posted in the hazardous waste accumulation area in Building 1; Hazardous waste accumulation areas were not designated in Buildings 3, 10, 12, and 20; the company was operating as a TSD facility by accumulating hazardous waste in Building 17 for greater than 90 days without being in compliance with TSD facility requirements; and there were open drums of hazardous waste in Buildings 3, 4, 8, 11, and 12.[17]

A Site Inspection (SI) of the TI facility was completed by the State in 1985 and updated in 1990. Based upon the information presented in the SI report, and in acknowledgment of the State program's continued lead in addressing the site, the TI facility was assigned a low priority for Federal Superfund action.[49]

In 1995, TI entered an agreement with Thomas & Betts to lease the building located at 33 Perry Avenue, and with D&G Realty to lease the building located at 25 Forest Street.[46]

In 1996, during TI's Nuclear Decommissioning Project, approximately 400 cubic yards of TCE contaminated soil was excavated from the area near Building 11, where the second spill reportedly took place. After sampling and analysis in accordance with the Waste Management Plan contained in an Interim Measure Plan per the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000), the soil was transported to Envirocare of Utah, Inc. for disposal in accordance with their site operating license. TI believes that this may account for the material presumed to be send to an unknown location, as previously mentioned.[46]

Currently, TI utilizes the following 24 chemicals that were reported under "Community Right-to-Know" in the 1997 Superfund Amendments and Reauthorization Act (SARA) Tier II reports: ammonia persulfate, aqua ammonia, anhydrous ammonia, calcium hydroxide, chlorine, cupric chloride, ferric chloride, ferrous sulfate, gasoline, hydrochloric acid, hydrofluoric acid, isoparaffinic hydrocarbon, methanol, mineral oil, nitric acid, nitrogen, oxygen, potassium cyanide, potassium silver cyanide, propane, sodium cyanide, sodium hydroxide, sulfuric acid, and TCE.[5]

WASTE/SOURCE SAMPLING

Numerous possible sources of contamination that were identified during file review and on the December 1997 Stone & Webster site reconnaissance include:

1. 5,000-gallon Mineral Oil AST
2. 1,500-gallon Methanol UST
3. 275-gallon Diesel AST
4. 200,000-gallon and 150,000-gallon Fuel Oil ASTs
5. 2,000-gallon Trichloroethane AST
6. 1,000-gallon Diesel Oil AST
7. 500-gallon Diesel Oil AST
8. 2,000-gallon Gasoline UST
9. 2 - 200,000-gallon (each) Waste Treatment Equalization Holding ASTs
10. 7,100-gallon Ferrous Sulfate AST
11. 6,000-gallon Sulfuric Acid AST
12. 2,000-gallon Diesel AST
13. 2 - 2,100-gallon (each) Ferric Chloride Holding ASTs
14. 3,000-gallon Virgin Ferric Chloride AST
15. 5,000-gallon Waste Ferric Chloride AST
16. Chemical Control Facility
17. 40,000-gallon Fuel Oil AST
18. 1,000-gallon Diesel Fuel AST
19. Hazardous Waste Storage Facility
20. Former Sludge Lagoons
21. Historic Spills
22. Low-level Radioactivity Disposal Pit
23. Former Acid Neutralization Lagoon
24. Contaminated Soil
25. Discharge from Industrial Wastewater Treatment Plant

Description of Each Potential Source:

<u>Source 1 - 5,000-Gallon Mineral Oil Tank</u>

Source 1 is a 5,000-gallon steel mineral oil AST located at Building 1. The tank is located in an 11,000-gallon capacity containment area.[3]

Source 2 - 1,500-Gallon Methanol Tank

Source 2 is a 1,500-gallon steel methanol UST located at Building 1. The tank is double-walled with leak detection and corrosion protection.[3]

Source 3 - 275-Gallon Diesel Tank

Source 3 is a 275-gallon steel diesel oil AST located at Building 4. The tank is contained by concrete berms and has a 500-gallon capacity containment.[3]

Source 4 - 200,000-gallon and 150,000-gallon Fuel Oil Tanks

Source 4 is a 200,000-gallon steel fuel oil AST and a 150,000-gallon steel fuel oil AST, both located at Building 6. The tanks are enclosed in a 525,000-gallon concrete containment area.[3]

Source 5 - 2,000-gallon TCE Tank

Source 5 is a 2,000-gallon steel TCE AST. The tank is contained within a bermed section of the Building 6 fuel oil spill control area with a 525,000-gallon capacity containment area.[3]

Source 6 - 1,000-gallon Diesel Tank

Source 6 is a 1,000-gallon steel diesel AST. The tank is contained within a bermed section of the Building 6 fuel oil spill control area with a 525,000-gallon capacity containment area.[3]

Source 7 - 500-gallon Diesel Tank

Source 7 is a 500-gallon diesel AST. The tank is contained within a bermed section of the Building 6 fuel oil spill control area with a 525,000-gallon capacity containment area.[3]

Source 8 - 2,000-gallon Gasoline Tank

Source 8 is a 2,000-gallon steel gasoline UST located at Building 10. The tank is double-walled with leak detection and corrosion protection.[3]

Source 9 - 2 - 200,000-gallon (each) Waste Treatment Equalization Holding Tanks

Source 9 is two 200,000-gallon (each) steel above ground waste treatment equalization holding tanks located at Building 11, containing metal-bearing wastewaters. The tanks are enclosed in a 750,000-gallon capacity concrete containment area.[3]

Source 10 - 7,100-gallon Ferrous Sulfate Tank

Source 10 is a 7,100-gallon ferrous sulfate AST located at Building 11. The tank is contained within a bermed section of the equalization holding tanks spill control area.[3]

Source 11 - 6,000-gallon Sulfuric Acid Tank

Source 11 is a 6,000-gallon carbon steel sulfuric acid AST located at Building 11. The tank is contained within a bermed section of the equalization holding tanks spill control area.[3]

Source 12 - 2,000-gallon Diesel Tank

Source 12 is a 2,000-gallon steel diesel AST located at Building 11. The tank is contained within the waste treatment loading dock with an 8,750-gallon containment area.[3]

Source 13 - Two 2,100-gallon (each) Ferric Chloride Tank

Source 13 is two 2,100-gallon fiberglass ferric chloride above ground holding tanks for recycling located at Building 11. The tanks are located indoors in a 7,200-gallon concrete containment area.[3]

Source 14 - 3,000-gallon Virgin Ferric Chloride Tank

Source 14 is a 3,000-gallon fiberglass virgin ferric chloride AST located at Building 11. The tank is located indoors and is protected by a 7,500-gallon capacity sealed concrete containment area.[3]

Source 15 - 5,000-gallon Waste Ferric Chloride Tank

Source 15 is 5,000-gallon waste ferric chloride AST located at Building 11. The tank is located indoors and is protected by a sealed secondary 7,500-gallon containment coated with an impermeable epoxy.[3]

Source 16 - Chemical Control Facility

Source 16 is the chemical control facility at the site (Building 11). All chemicals are received through this building and then distributed to the appropriate manufacturing buildings. The facility consists of seven separate rooms with pitched floors whose drains are directed to several underground spill control storage tanks including five 200-gallon fiberglass tanks for alkalis, oxidants, acids, toxics, and neutrals, a 200-gallon steel tank for solvents, and a 500-gallon steel tank for oil/water.[3, 5]

Source 17 - 40,000-gallon Fuel Oil Tank

Source 17 is a 40,000-gallon steel above ground fuel oil storage tank. The tank is enclosed in a 60,000-gallon concrete containment area.[3]

Source 18 - 1,000-gallon Diesel Fuel Tank

Source 18 is a 1,000-gallon steel above ground diesel fuel oil storage tank. The tank is located within the Building 12 fuel oil storage containment area.[3]

Source 19 - Hazardous Waste Storage Facility

Source 19 is the hazardous waste storage facility at the site (Building 17). The facility houses wastes that include flammable materials, acids, cyanides, waste barium, solid wastes, TCE, and mixed solid waste. In addition, virgin oils are also stored separately in the building, as wells as numerous empty drums for recycling. At the time of the Stone & Webster's December 1997 site reconnaissance, there were approximately 50 drums of waste stored in the building. Substances are stored in the facility for no longer than 90 days.[5]

The facility is totally enclosed and explosion-proof. Inside the building is a bottled gas storage room and a cyanide storage room. The building's ventilation system is designed to maintain a continuous movement of air within the building as well as within spill containment trenches. Five holding trenches (four 250-gallon and one 3,000-gallon) have grated tops to allow easy access for pumping and visual inspections. The spill control is designed to separate flammables, oxidizers, acids, and cyanides.[3, 5]

Source 20 - Former Sludge Lagoons

Two sludge lagoons existed near the southeast corner of the site, southeast of Building 17, until 1981. It is reported that both sodium hydroxide and caustic sludges were deposited into these lagoons. The lagoons were closed and capped in 1981, following MADEQE requirements, with 3 inches of lime, 1 foot of clay, and 2 feet of fill, loam, and grading. The area is presently being used as an athletic field.[2, 5] Prior to capping, the sludge lagoons were available to all pathways. The former sludge lagoons will be considered a source. It is unknown whether the contaminated soil was removed prior to capping.

Source 21 - Historic Spills

According to Texas Instruments employees, there have been two known chemical spills on the site that occurred in 1959 and 1960. The first spill involved a leak from a nitric acid line, which in turn dissolved a ceramic line feeding solvent into Building 10. The spill reportedly originated near Building 10 and flowed into the original duck pond near Building 4. The spilled solvent was reportedly TCE. The total amount spilled was unknown. It is also unknown whether any cleanup of the spill or contaminated soil was carried out following the spill.[1]

The second spill occurred near Building 11 in a tank and drum storage area. Overflow from a nitric acid tank corroded a line to a solvent tank containing TCE. The spill containing both nitric acid and solvent flowed onto a nearby road bed and unpaved parking area. The quantity of chemicals involved in this spill event is unknown.[1]

Another third *suspected spill area is between Building 3 and 6 where tanks with solvents and drum storage were located in the past.* This spill is only suspected and has not been confirmed by TI personnel.

Based on the fact that TCE concentrations remain high in these three areas, M&E concluded that

continuous sources (Dense Non-Aqueous Phase Liquid [DNAPL]) probably exist at the site, and the cause of these sources is historic spills.

Historic spills will be considered a source available to all pathways.

Source 22 - Low-level Radioactivity Disposal Pit

A pit used to dispose of equipment contaminated by low-level radioactivity (located east of Building 10), was covered some time during the 1970s. Previously contaminated soil may also have been disposed of in this area, although TI has never suspected this. TI stated that historical evidence suggested that the disposal consisted of construction debris and wrecked-out building materials. During the 1970s, buried contaminated machinery and metallic parts were removed when a buried pipeline was laid through the disposal area. Burial operations probably occurred primarily in the mid- to late 1950s. Later burials may have occurred, but no later than approximately 1964. The radioactive burial site was remediated during 1992 and 1993 under the direction of the Nuclear Regulatory Commission. Currently it is a grass-covered area.[2]

Source 23 - Former Acid Neutralization Lagoon

A small acid neutralization lagoon was located east of Building 10 (as shown on a 1965 aerial photograph of the site) and was apparently filled in at a later date. The approximate size of this lagoon was 20 feet by 40 feet. It has been suggested that this lagoon was a potential source of the VOCs detected in the soil and groundwater in its vicinity.[2] The lagoon is now covered by a paved parking lot.[46] This lagoon will be considered a source available to the groundwater pathway.

Source 24 - Contaminated Soil

Virgin petroleum (#6) contaminated soils were discovered during a construction project in April, 1989 in the area north of Building 6, west of Building 4, and south of Building 3. The contaminated soils surrounded the supply and return lines to an abandoned 60,000-gallon concrete underground storage tank which stored the oil. The contaminated soil was partially excavated.[2]

Source 25 - Discharge from Industrial Wastewater Treatment Plant

TI installed an industrial wastewater treatment plant in 1977 to treat wastewaters that are generated during the cleaning and chemical processing phases of manufacturing. The treatment plant is located in an addition to Building 11, adjacent to the Plating Department. Wastewater is discharged under a NPDES Permit at five discharge outfalls (001 through 005). One of these outfalls (003) was permitted to discharge treated industrial wastewater. Wastewater from outfall 003 is discharged to Cooper's Pond.[10]

Upon evaluation of the 25 items listed above, four will be considered potential sources -- the former sludge lagoons, historic spills, the former acid neutralization lagoon, and discharge from the industrial wastewater treatment plant.

Potentially hazardous substances which have been disposed, used, or stored on the property are

presented in Appendix B.

In March 1981, pH analysis was accomplished by taking 9 individual samples of sludge from each lagoon. All samples from the lagoon A (to the left of the entrance driveway) were mixed together, as were all samples from lagoon B (to the right of the entrance driveway). pH results from lagoon A showed the sludge to be alkaline at 8.2 and for lagoon B at 9.5. TI noted that this was expected due to the high quantity of lime that was observed mixed throughout the lagoons for stabilization. During the 1992 to 1994 Characterization Phase of the Nuclear Decommissioning Project, over 5,000 discrete soil samples were collected and analyzed for radionuclides.[46]

Discharge from the industrial wastewater treatment plant into Cooper's Pond is sampled on a monthly basis. Contaminants detected in the discharge include the following: aluminum (0.0837 mg/L), cadmium (0.0016 mg/L), chromium (1.5 mg/L), copper (0.177 mg/L), iron (0.145 mg/L), lead (0.0064 mg/L), nickel (0.1007 mg/L), palladium (0.108 mg/L), selenium (0.0065 mg/L), silver (0.008 mg/L), tin (0.0095 mg/L), zinc (0.189 mg/L), chlorine (0.01 mg/L), cyanide (0.03 mg/L), fluoride (1.3 mg/L), and boron (1.315 mg/L). Because these samples were collected directly from the discharge stream a background sample was not collected.[14]

No other source sampling has occurred on site.

GROUNDWATER PATHWAY

The TI site is located in the northwesterly portion of the Narragansett Basin, a structural and topographic depression which trends northeasterly through eastern Rhode Island and southeastern Massachusetts. The 960-square mile area of the Narragansett Basin is underlain by clastic rocks of late Pennsylvanian age. The total thickness of the sedimentary basin is not known but is estimated to be between 12,000 and 22,000 feet.[2]

Surficial geology of the area is dominated by glacial deposits resulting from the Pleistocene "Ice Age." Ancient valleys of the Narragansett Bay area were filled with unconsolidated glacial deposits of clay, silt, sand, gravel, and boulders. This till material is thicker in the valley floors and thin or absent on the uplands. Nonglacial alluvium is minor but does occur along some stream valleys.[2]

The bedrock at the TI site is characterized as Rhode Island formation, consisting of discontinuous alternations of conglomerates, sandstones, and siltstones. Folding, faulting, and fracturing are common in this geologic structure. A northeast-southwest orientation of the major fractures is suspected. There is no evidence of laterally continuous fracture zones across the site, but certain bedrock wells were found to be hydraulically connected. Bedrock surface elevations increase from 80 feet at the west end of the site to 115 feet at the east end. Groundwater availability at the site is generally greater in bedrock than in overburden material. TI currently requires up to 100 million gallons per year of industrial process water from four wells on the site (TI-1, 3, 7, and 11). Yields in these wells, which are 180 to 273 feet deep, range between 24 to 67 gallons per minute (gpm). The presence of these wells affects the bedrock groundwater flow direction in the area where they are pumping. In addition, development at the TI site has further altered some of the natural hydrologic features of the local aquifers. Paving, leveling, excavating, and filling have changed the runoff-related properties of the surface. It is expected that much less rainfall replenishes the aquifer

under the paved portions of the site compared to the aquifer under the open wooded lands north and east of the site. [2]

Shallow groundwater at the site is typically found at depths of 4 to 8 feet below the ground surface in the surficial sand and gravel deposits. United States Geologic Survey (USGS) reports indicate that the glacial deposits on the site can be expected to yield very small to moderate supplies of groundwater.[2]

Alluvial and glacial deposits northwest and southwest of the site, proximate to the Bungay River and Ten Mile River, yield significant quantities of water. The City of Attleboro used to maintain several production wells in unconsolidated sediments north of the site, off Holden Street, but were reportedly shut down due to high amounts of iron in the water. [2]

A subsurface drainage system has been installed at the western end of the site mainly for storm water runoff control. The drainage pipes were placed below the water table and there is evidence that the system also collects groundwater and locally lowers the water table. The operation of the groundwater collection and treatment system installed in 1986 further modifies the natural groundwater flow regime. [2]

Piezometric head measurements taken at different times, as summarized in the TI May 1990 and 1992 semi-annual reports, suggests that a groundwater flow divide bisects the site at Building 10. Groundwater east of Building 10 flows towards the east, and groundwater to the west of Building 10 flows to the west.[2] (See Figure 3)

The City of Attleboro does not obtain its drinking water from groundwater sources.[9] Drinking water is discussed in the Surface Water Pathway section of this report.

The following towns are within a 4 mile radius of the site: North Attleboro, Rehoboth, Mansfield, and Norton.[11] None of these towns obtain drinking water from a public well within 4 miles of the TI site.[27, 28, 29, 30] The population served by private groundwater wells is presented in Table 1.

Annual precipitation for the vicinity of the site is 43.81 inches.[8]

Table 1
Estimated Drinking Water Populations Served by Groundwater Sources Within Four Miles of the Texas Instruments Site

Radial Distance From the Texas Instruments site (miles)	Estimated Population Served by Private Wells	Estimated Population Served by Public Wells	Total Estimated Population Served by Groundwater Sources Within the Ring
0 to 0.25	0	0	0
> 0.25 to 0.5	0	0	0
> 0.5 to 1	0	0	0
> 1 to 2	90	0	90
> 2 to 3	416	0	416
> 3 to 4	1,072	0	1,072
TOTAL	1,578	0	1,578

[6]

Groundwater Sampling

Numerous rounds of groundwater sampling have been performed on site over the past two decades. Groundwater samples were collected by NUS, TI, GEI, and ESC, as described below.

VOC contamination in groundwater was first detected in 1983. A hydrogeological investigation was undertaken in December 1983 and January 1984 by NUS to investigate the source of low level organic contamination that had been found in TI's own production wells. The production wells are used in the manufacturing process at TI. According to the MADEQE, the wells contained TCE and dichloroethylene in the low ppb range (exact concentrations are unknown).[26]

TI sampled two wells assumed to be downgradient of the sludge lagoons in April, 1981. Well #16 is located 150 feet north of the lagoons and was drilled to a depth of 150 feet. Well #3 is located approximately 650 feet east of the lagoons and was drilled to a depth of 600 feet. All samples were analyzed for heavy metals. TI's analytical results indicated no values above background levels for all metals analyzed for except iron, which was found to be 2.1 ppm.[23] (Note: a background sample was not provided in the reference literature for this report.)

In December 1983, A&W Artesian Well (A&W) installed 11 bedrock monitoring wells under the direction of ESC (MW-1 through MW-7, MW-9, and MW-11 through MW-13) and 8 overburden monitoring wells (1S through 8S). Groundwater from the wells was analyzed for TCE.[41] TCE concentrations are presented in Table 2.

Table 2
TCE Concentrations in Groundwater
December 1983

Well #	TCE Concentration (ppb)
MW-1	22,800
1S	29,050
3S	39,200
MW-4	11,900
4S	1,590
6S	40
8S	9,560
MW-9	33.5

[41]

In July 1984, Guild Drilling Company installed three shallow and one deep bedrock monitoring well under the direction of GEI. Shallow wells (GEI-101, 102, and 103) were installed west of the groundwater divide to monitor quality of groundwater migrating to the site from the north and from the site to the south. The deep bedrock well (GEI-104) was installed south of Building 12. All monitoring wells (including those installed by A&W) were sampled and analyzed for VOCs. Contaminants detected include (highest concentration and location provided in parentheses) vinyl chloride (440 ppb, 1S), methylene chloride (14 ppb, 1S), chloroform (230 ppb, GEI-102), 1,1-dichloroethylene (480 ppb, 1S), 1,1-dichloroethane (230 ppb, 1S), 1,2-trans-dichloroethylene (69,000 ppb, 1S), 1,1,1-trichloroethane (660 ppb, GEI-102), TCE (170,000 ppb, 1S), and tetrachloroethylene (8,800, location unknown).[42]

In 1986 and 1987, GEI added 8 more overburden wells to the wells previously installed under their supervision. Details of these wells are unknown.[43]

TI has been performing semi-annual groundwater sampling since 1987. Samples are collected from on-site monitoring wells to monitor groundwater conditions, as well as discharge from the groundwater treatment system to monitor its performance. The samples are analyzed for volatiles, purgeable halocarbons, and aromatics.[46] Annual sampling reports submitted to the MADEP include laboratory data, chains of custody, and sampling procedures.[2] It has been reported that groundwater contamination by TCE (0.5 ppb to 600,000 ppb), tetrachloroethene (trace to 1,800 ppb), 1,1-dichloroethylene (trace to 1,800 ppb), cis-1,2-dichloroethylene (1 ppb to 5,600 ppb), t-1,2-dichloroethylene (0.9 ppb to 14,000 ppb), vinyl chloride (trace to 1,600 ppb), 1,1,1-trichloroethane (0.6 ppb to 170 ppb), and 1,1-dichloroethane (0.7 ppb to 410 ppb) has been documented in the aquifer underlying the site.[2]

In general, there are two primary areas of high concentrations of TCE in groundwater. These areas, based on historical information, are the areas where solvent spills have occurred. These areas are located between Buildings 3, 4, and 6 (in the vicinity of wells BW-1, OW-1, GEI-110 and MS-1S), and to the south of Building 10 (in the vicinity of MW-8S). See Figure 4 for sampling locations. In their 1996 Phase II Scope of Work, M&E concluded that, based on the fact that TCE concentrations remain high in these areas, it can be assumed that continuous sources of contamination (DNAPL) probably exist at the site.[4]

In July 1990, M&E prepared a Groundwater Contamination Study for the TI site. The broad objectives of the study were to better define the hydrogeologic conditions at the site before and after the installation of the groundwater treatment system; to assess the current extent and the development of the groundwater contamination plume over time; and to evaluate the effectiveness of the present remedial system and propose any additional remediation, if required. M&E concluded that converging evidence suggests that three on-site areas and one off-site area are the sources of groundwater contamination, due to past spills of VOCs. Analysis of past data show that TCE concentrations reduced drastically between 1986 and 1990, presumably due to the start-up of the groundwater treatment system.[43]

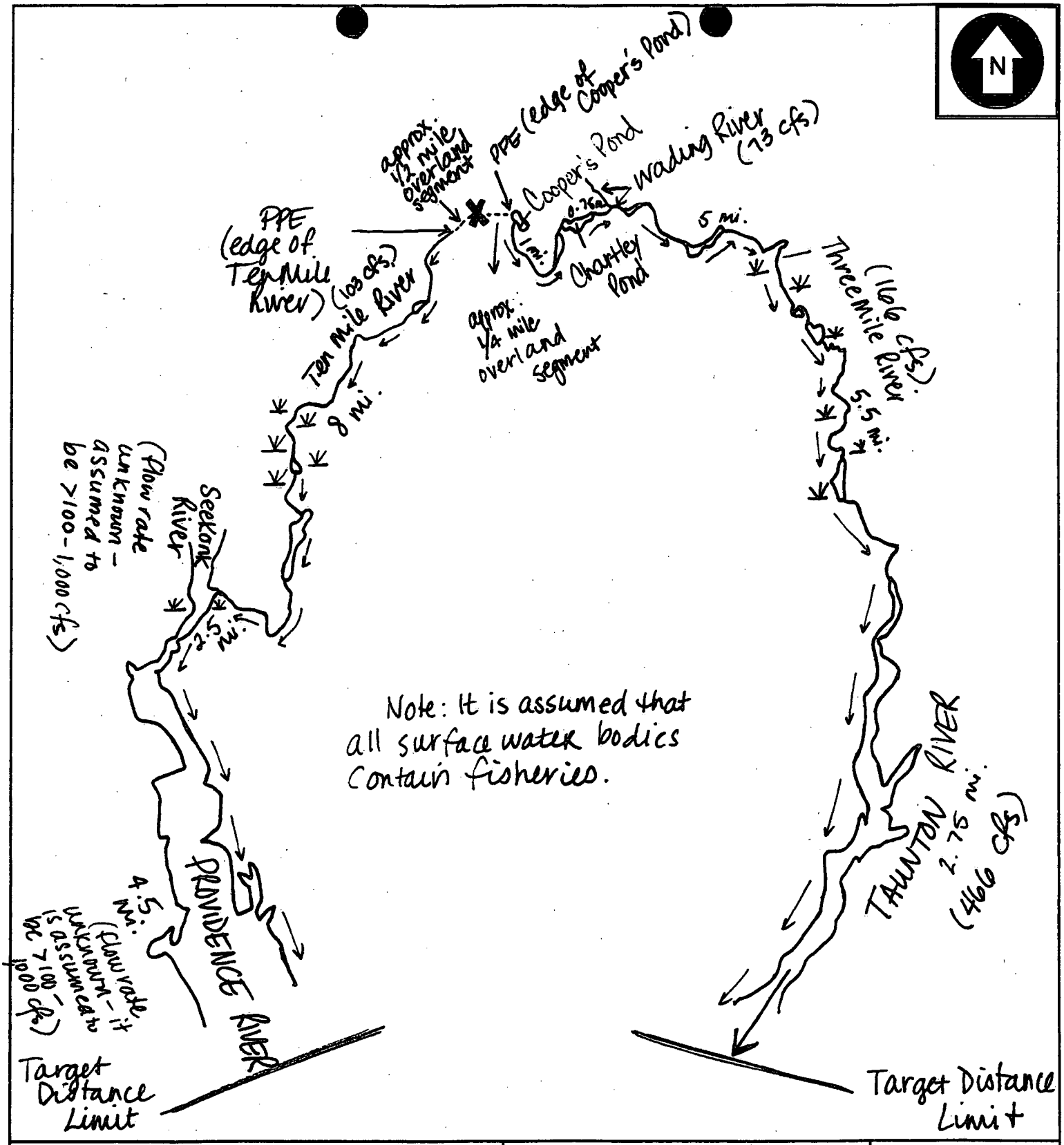
A release of TCE and other solvents to the groundwater has been documented by chemical analysis. TCE is directly attributed the TI site, however, the presence of an off-site source is indicated by the contamination found in shallow wells upgradient of identified spill areas and other contaminant sources on site.[42] There are no potential receptors, as groundwater is not used for drinking water purposes.

Groundwater sampling results from the first and second halves of 1996 are presented in Appendix C.

SURFACE WATER PATHWAY

Wastes released on site may impact surface waters via three mechanisms: runoff from areas impacted by historical spills, direct discharge of industrial wastewater treatment plant effluent to Cooper's Pond, and/or contaminated groundwater discharging to surface waters.

The TI site is essentially flat. The eastern portion of the site is approximately 135 feet above sea level. The western portion of the site is approximately 124 feet above sea level, allowing for an approximate 10 foot change in elevation across the site. The site is located in mixed Zone A (100-year flood zone) and Zone C (area of minimal flooding), as defined on the Federal Emergency Management Agency's Flood Insurance Rate Map.[36] Runoff in the western portion of the site is directed to the south, under a railroad track, toward Forest Street and the Ten Mile River. The length of the overland segment for the western portion of the site is approximately 0.5 mile. The in-water segment includes the following: the Ten Mile River (8 miles), the Seekonk River (2.5 miles), and the Providence River for the remainder of the 15-mile pathway. The Providence River ultimately flows into Narragansett Bay (see Figure 5).[11, 12] It is assumed that all portions of the in-water segment contain fisheries. The probable point of entry (PPE) of site contaminants from the western portion of the TI facility entering surface waters is along the bank of the Ten Mile River, where



BASE MAP IS A PORTION OF PROVIDENCE, RHODE ISLAND (1984) 30 MINUTE SERIES USGS TOPOGRAPHIC MAPS.

Stone & Webster
Environmental Technology and Services
Boston, Massachusetts

Date: 12/31/97
CERCLIS No.: MAD 007325814

Surface Water Pathway
TEXAS INSTRUMENTS, INC.
Figure 5

overland runoff enters the river. See Table 3 for a description of the water bodies within the Providence River watershed.

Table 3
Water Bodies Within the Surface Water Segment of the Texas Instruments Site
(Western Portion of the Site - Providence River Watershed)

Surface Water Body	Descriptor[a]	Length of Reach	Flow Characteristics (cfs)[b]	Length of Wetlands
Ten Mile River	Moderate to Large Stream	8 miles	103 cfs	2 miles
Seekonk River	Moderate to Large Stream	2.5 miles	>100 to 1000 cfs*	1 mile
Providence River	Moderate to Large Stream	4.5 miles	>100 to 1000 cfs*	0 miles

[12, 40]
[a] Minimal stream. Small to moderate steam. Moderate to large stream. Large stream to river. Very large river. Coastal tidal waters. Shallow ocean zone or Great Lake. Deep ocean zone or Great Lake. Three-mile mixing zone in quiet flowing river.
[b] Cubic feet per second.
* Information regarding these flowrates was unavailable during preparation for this report. This flow rate is an estimation.

Overland runoff east of Building 10 is directed to the north and east toward the duck pond and Cooper's Pond and ultimately flows into the Taunton River watershed. The length of the overland segment for the eastern portion of the site is approximately 0.25 mile. The in-water segment includes the following: Cooper's Pond (1 mile), Chartley Pond (0.75 mile), Wading River (5 miles), Three Mile River (5.5 miles) and the Taunton River for the remainder of the 15-mile pathway (see Figure 5). The Taunton River ultimately flows into Mount Hope Bay and then Narragansett Bay.[11, 12] It is assumed that all portions of the in-water segment contain fisheries. See Table 4 for a description of the water bodies within the Taunton River watershed. There are two PPEs for site contaminants from the eastern portion of the TI facility entering surface waters. Overland runoff flows to Cooper's Pond, and industrial wastewaters from the treatment plant are discharged into Cooper's Pond. TI has discharged wastewater via this outfall since the plant began operations in 1977. Currently, approximately 423,000 gallons of treated wastewater are discharged per day to Cooper's Pond.[39]

Table 4
Water Bodies Within the Surface Water Segment of the Texas Instruments Site
(Eastern Portion of the Site - Taunton River Watershed)

Surface Water Body	Descriptor[a]	Length of Reach	Flow Characteristics (cfs)[b]	Length of Wetlands
Cooper's Pond	Small to moderate stream	1 mile	10 - 100 cfs	0 miles
Chartley Pond	Small to moderate stream	0.75 mile	10 - 100 cfs	0 miles
Wading River	Small to moderate stream	5 miles	73 cfs	0 miles
Three Mile River	Moderate to large stream	5.5 miles	166 cfs	3.5 miles
Taunton River	Moderate to large stream	2.75 miles	466 cfs	0 miles

[12, 40]

[a] Minimal stream. Small to moderate steam. Moderate to large stream. Large stream to river. Very large river. Coastal tidal waters. Shallow ocean zone or Great Lake. Deep ocean zone or Great Lake. Three-mile mixing zone in quiet flowing river.

[b] Cubic feet per second.

The total length of wetlands along the 15-mile surface water pathway distance for the western portion of the site is approximately 3 miles. The total length of wetlands along the 15-mile surface water pathway for the eastern portion of the site is approximately 3.5 miles.[11, 12] Endangered species information for this site is unknown.

The City of Attleboro obtains its drinking water from several surface water reservoirs, none of which are located along the 15-mile downstream pathway.[31, 32, 33, 34, 35]

Surface Water Sampling

In March 1981, a metals analysis of the surface water running parallel to the sludge lagoons was completed (see Figure 4). Metal analysis performed on the surface water samples yielded the following results, none of which are greater than background levels: gold (<0.01 mg/L), zinc (0.02 mg/L), boron (<0.01 mg/L), phosphorus (0.11 mg/L), cadmium (<0.01 mg/L), iron (0.04 mg/L), tin (<0.01 mg/L), silver (<0.01 mg/L), copper (0.05 mg/L), lead (<0.01 mg/L), nickel (<0.01 mg/L), aluminum (0.06 mg/L), and chromium (<0.01 mg/L).[24]

In July 1984, GEI prepared a Supplemental Hydrogeologic Assessment and Recommendation for Remedial Action for the site. Part of the field program consisted of collecting four surface water samples. Samples were collected on and adjacent to the site and were analyzed for VOCs. The

concentration of total VOCs in surface water samples collected by GEI from an off-site wetland south of Building 11 was 30 ppb (SW-1). Just downstream of the wetland on the TI site, but prior to a catch basin into which the wetland flows, the concentration was 0 ppb. North of the site, slightly east of the surface water divide, two surface water samples were taken from the southerly flowing unnamed stream (labeled "Small Stream" on Figure 4). The upstream sample (SW-4) showed zero contamination. The downstream sample (SW-3) contained 70 ppb of total VOCs. GEI concluded that this data shows that an off-site source of VOCs is present between SW-4 and SW-3, and they noted that a dry cleaning establishment nearby may be the source.[42]

Outfall 007 is also sampled on a monthly basis. Outfall 007 is located in Cooper's Pond -- the sampling point being located prior to where the pond water flows into a drainage pipe. Samples are analyzed for inorganic compounds, pesticides/PCBs, volatiles, and semivolatiles. The most recent sampling data available during review for this report (December 1997) yielded the following: aluminum (0.489 mg/L), cadmium (0.005 mg/L), chromium (0.012 mg/L), copper (0.127 mg/L), iron (0.716 mg/L), lead (0.0064 mg/L), nickel (0.167 mg/L), platinum (0.022 mg/L), silver (0.027 mg/L), zinc (0.067 mg/L), and tin (0.009 mg/L). [14]

A release to surface water has been documented by chemical analysis. It can not be determined that there was a release of metals since metals are naturally occurring and a background sample was not collected. However, chlorine, cyanide, fluoride, and boron may not be naturally occurring elements, and, therefore, constitute a release to surface water. Cooper's Pond, a potential receptor because it is a fishery, has been impacted by this release. Wetlands surrounding Cooper's Pond have not been sampled to document contamination of a sensitive environment.

SOIL EXPOSURE PATHWAY

The total number of workers on site is approximately 5,200.[5] The total population within a one mile radius of the site is approximately 7,662.[6] The nearest residence borders the site to the north, although residences border the site to the west, northwest, and northeast as well.[5] There are no schools or day care facilities within 200 feet from an area of observed contamination on the TI site.[5] Access to the site is not restricted. Several private roads traverse the site and, although the roads have gates that can be closed at times, normally, the general public has access to these roads. In addition, two ball fields and a walking trail are located on site and are available to TI employees for recreational use.[5]

There are no terrestrial sensitive environments on site.[5]

M&E conducted a soil gas survey at TI on November 5 through 7, 1996 to evaluate potential source areas of TCE in the overburden. The soil gas survey targeted historic spill areas and identified any past or present solvent storage areas to evaluated whether pooled or DNAPL exists in the vadose zone or saturated overburden. A secondary use of the soil gas survey was to evaluate the extent of the chlorinated plume and determine the potential need for, and location of, soil borings to further evaluate the extent of soil contamination.[47]

The results of the soil gas survey revealed concentrations of TCE above the detection limit of the instrument in eleven areas throughout the site. The highest concentration of soil gas survey hits were located in three areas -- the area between Buildings 10 and 11 at the northwest corner of Building 11, the area located south of Building 3 and west of Building 6, and the area to the south of Building 1.[47]

There has been no other comprehensive soil sampling conducted on site.

A release to the surface soil at the TI site has not been documented.

AIR PATHWAY

The nearest individuals are the 5,200 employees on site.[5] The residential population within 4 miles of the site is 52,836, as shown on Table 5.[6] The number of workers within 4 miles was not investigated.

Table 5
Estimated Population Within Four Miles of
Texas Instruments, Inc.

Radial Distance From Texas Instruments, Inc. (miles)	Estimated Population
0.00 to 0.25	154
> 0.25 to 0.50	1,039
> 0.50 to 1.00	6,469
> 1.00 to 2.00	13,281
> 2.00 to 3.00	13,965
> 3.00 to 4.00	17,928
TOTAL	52,836

[6]

Sensitive environments within the surface water pathway include wetlands on site and within a 4-mile radius of the site. Wetland acreage within 4 miles of the site was estimated to be approximately 1,695 acres.[11, 12] Endangered species information is not currently available.

TI has performed air discharge sampling to verify compliance with air permit requirements. In addition, TI conducted perimeter air sampling in accordance with the Health & Safety Plan during the Nuclear Decommissioning project. Analytical results for each of these sampling events were not available during review for this report. Aside from the sampling previously mentioned, no environmental air sampling has been routinely conducted at the TI Attleboro site.[46]

A release to the air pathway at the TI site has not been documented.

SUMMARY

Texas Instruments, Inc. is located at 34 Forest Street in Attleboro, Massachusetts. The site is approximately 275 acres in size, 30 of which are paved parking areas. There are 17 industrial manufacturing and/or office buildings located on site. The site is located in a mixed industrial/residential area. The Texas Instruments site is a major industrial plant in southeastern Massachusetts, manufacturing clad metals, electronic control devices, semi-conductors and assorted formed-metal products.

According to Texas Instruments employees, there have been two chemical spills that occurred on the TI site in 1959 and 1960. Several potential sources of contamination exist at the site including the above-mentioned chemical spills, former sludge lagoons, a former acid neutralization lagoon, and the discharge from the industrial wastewater treatment plant into Cooper's Pond.

Groundwater contamination was first discovered in TI's own production wells in 1983. Groundwater at the Texas Instruments site was independently sampled numerous times in the past two decades. Analytical results indicated the presence of vinyl chloride, 1,2-trans-dichloroethylene, 1,1-dichloroethylene, TCE, tetrachloroethylene, 1,1,1-trichloroethane, 1,1-dichloroethane, methylene chloride, and chloroform. Texas Instruments has been performing semi-annual groundwater sampling since 1987 during which the above-mentioned contaminants have been detected.

In March 1981, a metal analysis of the surface water running parallel to the sludge lagoons was conducted. The following metals were detected: gold, zinc, boron, phosphorous, cadmium, iron, tin, silver, copper, lead, nickel, aluminum, and chromium. In July 1984, surface water samples were collected on and adjacent to the site. VOCs were detected on site and downstream of the site. Outfall 007, the sampling point located prior to where the pond water from Cooper's Pond flows into a drainage pipe, is sampled on a monthly basis. Contaminants detected include aluminum, cadmium, chromium, copper, iron, lead, nickel, platinum, silver, zinc, and tin. Discharge from the industrial wastewater treatment plant into Cooper's Pond is also sampled on a monthly basis. Contaminants detected in the discharge include heavy metals, chlorine, cyanide, fluoride, and boron.

There has been no comprehensive soil sampling conducted on site.

The only air sampling performed on site includes air discharge sampling to verify compliance with air permit requirements and sampling to monitor air quality during exterior remediation for the nuclear decommissioning project. No perimeter air sampling has been conducted at the TI site.

The City of Attleboro does not obtain its drinking water from groundwater sources, nor do cities and towns within a 4 miles radius of the site. The population served by private groundwater wells within four miles of the site is 1,578. The nearest private groundwater well is located between 1 and 2

miles of the site.

Surface water could be impacted by sources in the following ways: overland flow (surface water runoff from areas impacted by historical spills), direct discharge (of the industrial wastewater treatment plant), and groundwater to surface water discharge (since groundwater is found at a shallow depth).

Surface water in the western portion of the site is directed to the south, under a railroad track, toward Forest Street and the Ten Mile River. The length of the overland segment for the western portion of the site is approximately 0.5 mile. The in-water segment up to the 15-mile surface water pathway limit includes the following: the Ten Mile River (8 miles), the Seekonk River (2.5 miles), and the Providence River for the remainder of the 15-mile pathway. The Providence River ultimately flows into Narragansett Bay. It is assumed that all portions of the in-water segment contain fisheries. The edge of the Ten Mile River is the PPE for the western portion of the site.

Runoff of natural surface water east of Building 10 is directed to the north and east toward the duck pond and Cooper's Pond, and ultimately flows into the Taunton River watershed. The length of the overland segment for the eastern portion of the site is approximately 0.25 mile. The in-water segment up to the 15-mile surface water pathway limit includes the following: Cooper's Pond (1 mile), Chartley Pond (0.75 mile), Wading River (5 miles), Three Mile River (5.5 miles) and the Taunton River for the remainder of the 15-mile pathway. The Taunton River ultimately flows into Narragansett Bay. It is assumed that all portions of the in-water segment contain fisheries. Cooper's Pond is the PPE for the eastern portion of the site. A third PPE is an unnamed surface stream that flows into Cooper's Pond. Wastewater from the industrial wastewater treatment plant is discharged to Cooper's Pond via a discharge channel.

There are no residents or day care facilities on the Texas Instruments site.

The residential population within 4 miles of the site is 52,836. Sensitive environments within the 15-mile surface water pathway limit include wetlands on site and within a 4-mile radius of the site. Wetland acreage within 4 miles of the site was estimated to be approximately 1,695 acres.

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Appendix A
Potential Sources of Contamination
Within One Mile of the Texas Instruments Site

TYPE	SITE/ID/STATUS	ADDRESS	DIS/DIR
CERCLIS	Attleboro Gas Works MAD980520985/Not Proposed	Dunham & Pine Streets Attleboro, MA 02703	0.46 SW
CERCLIS	Attleboro WWTP (Old) MAD075710475/NFRAP	25 South Main Street Attleboro, MA 02703	0.51 SW
CERCLIS	Finberg Field MAD985280775/Not Proposed	Park & Bishop Streets Attleboro, MA 02703	0.96 SE
CERCLIS	Glines & Rhodes MAD052629979/Not Proposed	189 East Street Attleboro, MA 02703	0.65 SE
CERCLIS	Handy & Harman (Former) MAD980520720/NFRAP	42 Union Street Attleboro, MA 02703	0.46 SE
CERCLIS	Holden Street Fill Area MAD985286335/NFRAP	Off Holden Street Attleboro, MA 02703	0.42 NW
CERCLIS	Marathon Co. MAD001207638/NFRAP	90 O'Neil Blvd. Attleboro, MA 02703	0.52 SE
CERCLIS	RF Simmons Co. (Former) MAD075713487/Not Proposed	191 North Main Street Attleboro, MA 02703	0.52 SE
CERCLIS	Robbins Co. Inc. MAD001198639/Not Proposed	191 North Main Street Attleboro, MA 02703	0.70 NW
RCRA	Samson Oil Service MAD075693572/RCRACOR	84 Pleasant Street Attleboro, MA 02703	0.18 NW
RCRA	ABR Auto Body MAD982199242/VGN	60 Holman Street Attleboro, MA 02703	0.18 SW
RCRA	Alviti Creations MAD001620012/VGN	67 Mechanic Street Attleboro, MA 02703	0.87 SW
RCRA	American Metal Craft MAD001191170/VGN	53 Falmouth Street Attleboro, MA 02703	0.13 SW
RCRA	Anderson Chrysler Plymouth MAD047983622/VGN	676 Pleasant Street Attleboro, MA 02703	0.82 NE
RCRA	Automatic Machine Product MAD001199223/LGN	17 Wall Street Attleboro, MA 02703	0.66 SW
RCRA	Balfour LG Foundation MAD001199256/LGN	25 County Street Attleboro, MA 02703	0.52 SW

TYPE	SITE/ID/STATUS	ADDRESS	DIS/DIR
RCRA	Barry Ind. Inc. MAD080818941/SGN	67 Mechanic Street Attleboro, MA 02703	0.87 SW
RCRA	Checon Corp. MAD001623867/SGN	84 Dunham Street Attleboro, MA 02703	0.38 SW
RCRA	Chemet Corp. MAD041172719/LGN	52 Gardner Street Attleboro, MA 02703	0.34 SW
RCRA	Cobbs Transmission Service MAD075701094/VGN	15 Atwood Street Attleboro, MA 02703	0.46 SW
RCRA	Composite Technical Alloy MAD059739110/VGN	1 Mill Street Attleboro, MA 02703	0.52 SW
RCRA	Contech Research, Inc. MAD041957150/VGN	67 Mechanic Street Attleboro, MA 02703	0.87 SW
RCRA	Eastern Case Parts Co., Inc. MAD001198951/SGN	34 Perry Avenue Attleboro, MA 02703	0.30 NE
RCRA	Fortifiber Corp. MAD093211530/SGN	55 Starkey Avenue Attleboro, MA 02703	0.38 NE
RCRA	Foster, Inc. MAD001199207/SGN	37 Union Street Attleboro, MA 02703	0.42 SW
RCRA	Foxon Packaging Corp. MAD062319553/VGN	54 Union Street Attleboro, MA 02703	0.46 SW
RCRA	Glines & Rhodes, Inc. MAD052629979/VGN	189 East Street Attleboro, MA 02703	0.65 SE
RCRA	Knobby Krafters, Inc. MAD001461656/VGN	200 North Main Street Attleboro, MA 02703	0.76 NW
RCRA	Krew, Inc. MAD001192376/SGN	101 Dunham Street Attleboro, MA 02703	0.41 SW
RCRA	Lance Buick Pontiac Cadillac MAD981065519/VGN	469 Pleasant Street Attleboro, MA 02703	0.37 NE
RCRA	Marathon Co. MAD001207638	O'Neil Boulevard Attleboro, MA 02703	0.52 SE
RCRA	Mobil Oil Corp. MAD985295385/VGN	495 Pleasant Street Attleboro, MA 02703	0.42 NE
RCRA	New England Tire MAD093207173/VGN	44 North Main Street Attleboro, MA 02703	0.52 SW
RCRA	Norking Co., Inc. MAD0518502847/VGN	53 County Street Attleboro, MA 02703	0.61 SW

TYPE	SITE/ID/STATUS	ADDRESS	DIS/DIR
RCRA	Paratronix, Inc. MAD054887294/SGN	129 Bank Street Attleboro, MA 02703	0.45 NW
RCRA	Pelletiers Automotive, Inc. MAD019158773/VGN	193 Pine Street Attleboro, MA 02703	0.77 SW
RCRA	Plastic Craft Novelty Co. MAD001200302/VGN	12 Dunham Street Attleboro, MA 02703	0.48 SW
RCRA	Pleasant Cleaners MAD019158864/VGN	504 Pleasant Street Attleboro, MA 02703	0.47 NE
RCRA	The Robbins Co, Inc. MAD001198639/SGN	O'Neil Boulevard Attleboro, MA 02703	0.79 SE
RCRA	RF Simmons Co., Inc. MAD985271618/VGN	225 O'Neil Boulevard Attleboro, MA 02703	0.79 SE
RCRA	Stern Leach & Leach Co. MAD063918072/SGN	200 East Street Attleboro, MA 02703	0.62 SE
RCRA	Stern Leach Co. MAD001208933/SGN	49 Pearl Street Attleboro, MA 02703	0.48 SW
RCRA	Swank, Inc. MAD001202340/LGN	6 Hazel Street Attleboro, MA 02703	0.51 SW
RCRA	Charles Thomae & Son, Inc. MAD001194091/VGN	15 Maynard Street Attleboro, MA 02703	0.12 SW
RCRA	U Haul Center MAD981890569/VGN	480 Pleasant Street Attleboro, MA 02703	0.39 NE
RCRA	Waste Systems, Inc. MAD985275478/SGN	217 O'Neil Boulevard Attleboro, MA 02703	0.73 SE

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Appendix B
Hazardous Waste Quantity for the Texas Instruments Site

Substance	Quantity or Volume/Area	Years of Use/Storage	Years of Disposal	Source Area
Tetrachloroethene	Found in Groundwater	N/A	N/A	Historic Spills
TCE	Found in Groundwater	Used from late 40s - Present	1950s - Present	Historic Spills, Infiltration of groundwater into storm drain system, Stored/used on site
1,1-Dichloroethylene	Found in Groundwater	N/A	N/A	Historic Spills, Degradation product of TCE
cis-1,2-Dichloroethylene	Found in Groundwater	N/A	1977-Present	Historic Spills, Degradation product of TCE
t-1,2-Dichloroethylene	Found in Groundwater	N/A	N/A	Historic Spills
Methylene Chloride	Found in Groundwater	late 40s - Present	1950s - Present	Historic Spills, used in manufacturing, contaminant of virgin TCE
Vinyl Chloride	Found in Groundwater	N/A	N/A	Historic Spills, Degradation product of TCE
1,1,1-trichloroethane (also known as methyl chloroform)	Found in Groundwater	1972-Present	N/A	Historic Spills, contaminant of virgin TCE
1,1-dichloroethane	Found in Groundwater	N/A	N/A	Historic Spills, degradation of 1,1,1-TCA
Aluminum	See Note A	Prior to 1970s - Present	Prior to 1970s - Present	Discharge from Industrial Wastewater Treatment Plant
Arsenic	Found in Groundwater	N/A	1977-Present	Trace Element
Barium	See Note A	1977 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, Stored/Used on site
Boron	Unknown	N/A	1977-Present	Discharge from Industrial Wastewater Treatment Plant, Trace element - Borax solution, used in manufacturing

Substance	Quantity or Volume/Area	Years of Use/Storage	Years of Disposal	Source Area
Cadmium	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Chromium	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Cobalt	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Copper	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Iron	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Lead	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Manganese	See Note A	N/A	1977-Present	Discharge from Industrial Wastewater Treatment Plant
Mercury	See Note A	N/A	1977-Present	Discharge from Industrial Wastewater Treatment Plant, found in gauges used
Nickel	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Silver	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Zinc	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant, used in manufacturing process
Chloroform	Found in Groundwater. Also See Note A.	N/A	1977-Present	Discharge from Industrial Wastewater Treatment Plant, degradation of chlorinated products
Cyanide	See Note A	1926 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant

Substance	Quantity or Volume/Area	Years of Use/Storage	Years of Disposal	Source Area
Chlorine (gas)	See Note A	1988 - Present	1977-Present	Discharge from Industrial Wastewater Treatment Plant
Ferrous Sulfate	7,100-gallon tank	1977 - Present	1977 - Present	Discharge from Industrial Wastewater Treatment Plant
Hydrochloric Acid	See Note A	1977 - Present	1977 - Present	Discharge from Industrial Wastewater Treatment Plant
Methanol	1,500-gallon tank (presently out-of-service)	Used from 1926-Present*	N/A	Stored/Used on Site
Nitric Acid	Found in Groundwater	Used from 1926-Present*	N/A	Stored/Used on Site, used in manufacturing process
Potassium Silver Cyanide	800 troy ounces/year	Used from 1926-Present*	N/A	Stored/Used on Site
Sulfuric Acid	6,000-gallon tank	1988 - Present	N/A	Stored/Used on Site
Selenium	Quantity Used Unknown	Used from 1926-Present*	N/A	Stored/Used on Site

[14]

Note A: Approximately 3,242,295,000 gallons of water have been discharged from the Industrial Wastewater Treatment Plant since it began operating in 1977.

* General Plate, manufacturers of metals and metal products, began operations at the site in 1926. It is assumed that these substances were used in the manufacturing process since operations began.

APPENDIX C
GROUNDWATER MONITORING WELLS - ANALYTICAL RESULTS
TEXAS INSTRUMENTS, ATTLEBORO, MA

Samples collected 4/22/96 - 6/30/96 FIRST HALF 1996

	Tetrachloroethene	TCE	1,1-dichloroethylene	cis-1,2-dichloroethylene	t-1,2-dichloroethylene	vinyl chloride	1,1,1-trichloroethane	1,1-dichloroethane
Overburden Wells								
GEI-106	4	86	BRL	3,300	BRL	6	BRL	BRL
GEI-110	100	36,000	BRL	3,300	BRL	BRL	BRL	BRL
GEI-111	6	250	BRL	180	BRL	BRL	1	BRL
G-113	2	26	47	BRL	BRL	BRL	59	7
MW-2S	18	14	BRL	3	BRL	BRL	BRL	BRL
MW-4S	BRL	11	BRL	300	BRL	20	BRL	BRL
MW-5S	BRL	4	BRL	BRL	BRL	BRL	BRL	BRL
MW-7S	BRL	7	BRL	BRL	BRL	BRL	BRL	BRL
MW-8S	40	4,900	33	1,000	BRL	190	BRL	BRL
TI-4S	BRL	1	BRL	7	BRL	BRL	0.8	BRL
OW-1	67	8,400	BRL	290	BRL	BRL	BRL	BRL
OW-2	130	7,700	BRL	1,600	BRL	BRL	BRL	BRL
OW-3	0.6	4	BRL	15	BRL	BRL	0.6	9
OW-4	110	3,200	BRL	170	BRL	BRL	BRL	BRL
OW-6	BRL	11	BRL	65	BRL	BRL	BRL	BRL
OW-7	BRL	4	BRL	26	BRL	BRL	BRL	BRL
RIZ-4	BRL	4	BRL	BRL	BRL	BRL	BRL	BRL
GZA-1	7	6	BRL	1	BRL	BRL	0.9	BRL

Samples collected 9/15/96 - 12/31/96 SECOND HALF 1996

Overburden Wells								
GEI-101	2	5	BRL	4	BRL	BRL	BRL	0.6
GEI-105	35	17	4	1	BRL	BRL	11	6
GEI-106	3	65	BRL	57	BRL	6	BRL	BRL
GEI-108	BRL	2	BRL	13	BRL	BRL	BRL	BRL
GEI-110	BRL	46,000	BRL	3,900	BRL	BRL	BRL	BRL

	Tetrachloroethene	TCE	1,1-dichloroethylene	cis-1,2-dichloroethylene	t-1,2-dichloroethylene	vinyl chloride	1,1,1-trichloroethane	1,1-dichloroethane
GEI-111	15	910	BRL	820	7	40	BRL	7
G-113	BRL	4	BRL	BRL	BRL	BRL	1	BRL
MW-1S	BRL	3	BRL	55	BRL	100	BRL	3
MW-2S	14	76	BRL	BRL	BRL	BRL	BRL	BRL
MW-5S	BRL	7	BRL	BRL	BRL	BRL	BRL	BRL
MW-7S	BRL	4	BRL	BRL	BRL	BRL	BRL	BRL
MW-8S	50	5,000	BRL	1,200	BRL	BRL	BRL	BRL
OW-1	50	8,300	BRL	160	BRL	BRL	BRL	BRL
OW-2	160	8,400	BRL	2,000	BRL	BRL	BRL	BRL
OW-3	0.6	17	BRL	26	BRL	BRL	BRL	11
OW-4	110	2,300	41	200	BRL	BRL	BRL	BRL
OW-7	BRL	22	BRL	37	BRL	BRL	BRL	BRL
RIZ-2A	46	14	4	6	BRL	BRL	24	5
Bedrock Wells								
TI-2	280	BRL	BRL	190	BRL	BRL	BRL	BRL
TI-4	BRL	1	BRL	BRL	BRL	BRL	BRL	BRL
TI-15	BRL	5	BRL	56	0.7	4	BRL	BRL
TI-16	2	120	2	240	BRL	BRL	3	1
MW-2	BRL	1	BRL	BRL	BRL	BRL	BRL	BRL
MW-3	BRL	940	BRL	BRL	BRL	BRL	BRL	BRL
MW-5	BRL	1	BRL	BRL	BRL	BRL	BRL	BRL
MW-7	BRL	20	BRL	3	BRL	BRL	BRL	BRL
MW-9	BRL	3	BRL	0.8	BRL	BRL	BRL	BRL
MW-12	45	65	BRL	19	BRL	BRL	BRL	BRL
BW-1	1,200	74,000	BRL	900	BRL	BRL	BRL	BRL
BW-2	46	1,900	BRL	690	BRL	BRL	BRL	BRL
BW-3	BRL	4	BRL	20	BRL	BRL	BRL	8
BW-5	BRL	370,000	BRL	BRL	BRL	BRL	BRL	BRL
GEI-104	BRL	15	BRL	5	BRL	BRL	1	1
Off Site Overburden Wells								
AUG-3	BRL	3	BRL	BRL	BRL	BRL	BRL	BRL

	Tetrachloroethene	TCE	1,1-dichloroethylene	cis-1,2-dichloroethylene	t-1,2-dichloroethylene	vinyl chloride	1,1,1-trichloroethane	1,1-dichloroethane
AP-1	BRL	3	BRL	BRL	BRL	BRL	BRL	BRL
QC-3	6	35	BRL	1	BRL	BRL	BRL	BRL
SHU-2S	15	3	BRL	3	BRL	BRL	BRL	BRL
Bedrock wells -- off site								
SHU-1	12	3	BRL	BRL	BRL	BRL	BRL	BRL
NRC Overburden Wells								
NRC-23	BRL	1	BRL	BRL	BRL	BRL	BRL	BRL

Notes: all units are µg/L, BRL = Below Reporting Limits